13. Each annular distributor duct 29 is connected to a single coaxial arrangement of plate exchangers 13; the same goes for each annular collector duct 30.

The aforementioned annular ducts 29 and 30 are also in fluid communication with the outside of the heat exchange unit 1, through respective ducts 31 for feeding and 32 for discharging said fluid, in turn respectively connected to one of the input passages 7 and to one of the discharge passages 8 for said heat exchange operating fluids.

Thanks to the configuration described above, in particular thanks to the use of plate exchangers 13, an optimisation of the heat exchange between the operating fluid on the shell side and the operating fluids flowing inside the plate exchangers 13 is obtained. Moreover, the problem of the use of many operating fluids is solved in a simple, cost-effective and easy to carry out way.

According to a preferred embodiment, the basket 14 is intended to contain a mass of an appropriate filler, for example marbles of inert solid material (not represented), in which the plate exchangers 13 are immersed and supported. Such a solution allows to further increase the overall heat exchange coefficient of the heat exchange unit according to the present invention.

According to a preferred embodiment, an operating fluid, entering through the passage 5 and coming out from the passage 6, crosses the exchanger on the shell side, coming into contact with the outside of the plate exchangers 13. The remaining three operating fluids enter through the passages 7, 8, 9 and are distributed separately, through the feed ducts 31 which extend from the aforementioned

passages 7, 8, 9, the annular distributor ducts 29 and the distributor connectors 27, each inside a different coaxial concentric arrangement of plate exchangers 13. At the outlet of said plate exchangers 13, the aforementioned three operating fluids cross the collector connectors 28, enter inside the respective annular collector ducts 30, to be transported, through the outlet ducts 32, to the respective discharge passages 10, 11, 12.

Moreover, to obtain optimal heat exchange efficiency between the operating fluid on the shell side and the operating fluids flowing inside the plate exchangers 13, the operating fluid on the shell side should cross the heat exchange unit in a substantially radial direction.

This is advantageously obtained thanks to the passage of the operating fluid on the shell side through an interspace 16, from which, through the perforated wall 15 outside of the basket, said operating fluid will enter into said basket, flowing in a radial direction through the concentric and coaxial arrangements of plate exchangers 13. From here, through the perforated wall 17 inside the basket, said operating fluid shall come out from said basket, to enter into the central duct 18, which leads to the outlet passage 6.

This allows said operating fluid to exchange heat, along its path inside the heat exchange unit, in sequence with the operating fluids inside the plate exchangers 13, in such a way allowing a heat exchange with a uniform gradient starting from the outer cylindrical wall 15 of the basket, through the different concentric rows of plate exchangers 13 up to the central collector duct 18. Said operating fluid on the shell side can, if necessary, also carry out

the outside through a respective tubular connector 27, 28, foreseen in said exchanger 13, in correspondence with the short side 22a thereof, from which the separator plate 46 overhangs.

With the present configuration, thanks to the inclined separator plate 46, the fluid proceeds along a path with a gradually increasing cross-section; this allows, when the operating fluid in question must undergo an expansion caused by the temperature, the speed of said operating fluid to be kept constant, balancing the expansion with a greater volume available to the fluid.

According to an alternative embodiment of the present invention (figures 10 to 13), each exchanger 13 is equipped, in correspondence with the opposite long sides 21, with a distribution duct 48 and respectively a collector duct 49 of said operating fluid. The ducts 48 and 49 are, on one side, in fluid communication with said chamber 26 through at least one, but preferably a plurality of openings or holes 50 and 51, with which they are equipped along one or more generatrices and, on the other side, with the outside of the exchanger 13, through respective connectors 27 and 28 for the entry and exit of said operating fluid.

According to a preferred embodiment of the present variant, said ducts 48 and 49 are "formed" directly in the long sides 21 of the exchanger 13, at the time of the drawing and perimetric welding of the metallic plates 23 and 24 which constitute it. Advantageously, they are obtained through welding lines 52a, 52b, extending parallel to the long sides 21, at a predetermined distance from the perimetric weldings 25, whereas the openings 53a, 53b for

the passage of fluid are obtained through appropriate interruptions of such weldings 52a, 52b.

Moreover, according to this alternative embodiment, the inner chamber of each exchanger 13 is subdivided into a plurality of chambers 55, not directly communicating with each other and obtained, for example, through a corresponding plurality of welding lines 56 of the metallic plates 23, 24, extending parallel to the short sides 22 of the exchanger 13, in other words perpendicular to the distributor and collector ducts 48, 49 thereof. Each chamber 55 is in fluid communication with said distributor duct 48, through at least one opening 50 thereof and with said collector duct 49, through at least one opening 51 thereof.

This alternative configuration allows the flow of the operating fluid, within the exchangers 13, to be directed in the intended direction, for example and in particular in the radial direction with respect to the axis of the reactor, with the consequent improved heat exchange efficiency.

In accordance with the present invention, said chamber 26 of said exchanger 13 may have, as represented in figure 14, a variable size along the direction parallel to the line of the inlet connectors, i.e. the distance between the plates 23a, 24b increases or decreases along said direction, so as to advantageously obtain a variation in speed of the operating fluid in the flow direction of the operating fluid itself.

According to a preferred embodiment, in the inner chamber 26 three zones 54a, 54c, 54e following each other in the

aforementioned flow direction AA of the operating fluid are defined, each of the three having a constant size but different as regards the other two zones. More specifically, said size shall be at its maximum in the zone 54a, at its minimum in the zone 54e and intermediate between these two at 54c. Said zones 54a, 54c, 54e communicate with each other through connector zones 54b, 54d converging in said direction AA. Preferably, said connector zones 54b, 54d are defined by appropriate pairs of folding lines (P1 and P2, respectively, above and below the zone 54b; P3 and P4, respectively, above and below the zone 54d) realised in the opposite plates.

This embodiment allows, in a simple manner from the constructive point of view, to keep substantially constant the heat exchange capacity (thanks to the reduction in the passage section thereof) and the efficiency of the heat exchangers 13, following the variation in density of the operating fluid inside the plate, with the consequent variation in speed which is thus kept preferably constant.

The invention thus conceived is susceptible to further variants and modifications all of which are within the capabilities of the man skilled in the art and, as such, fall within the scope of protection of the invention itself, as defined by the following claims.

CLAIMS

1. Heat exchange unit (1) of the so-called multiservice type comprising a substantially cylindrical shell (2) closed at the opposite ends by respective base plates (3, 4), a plurality of heat exchangers (13) supported inside this shell and in fluid communication with the outside thereof, characterised in that at least part of said exchangers are box-shaped plate exchangers, plate shaped, formed from a pair of juxtaposed metallic plates (23, 24) mutually distanced and perimetrically joined, to define an inner chamber (26) intended to be crossed a heat exchange fluid.

2. Heat exchange unit according to claim 1, characterised in that said plate exchangers (13) have a flattened configuration and are grouped in a cylindrical arrangement coaxial to the shell (2), where said plate exchangers (13) are arranged according to a radial configuration.

3. Heat exchange unit according to claim 1 or claim 2, characterised in that a group of a predetermined number of said plate exchangers (13) shares an inlet (27) and an outlet (28).

4. Heat exchange unit according to any one of the previous claims characterised in that said substantially cylindrical shell (2) is filled with a filler in which said plurality of plate exchangers (13) is immersed.

5. Heat exchange unit according to claim 1, characterised in that said metallic plates (23, 24) of at least one plate exchanger (13) are joined together through a plurality of welding points (34) which give a substantially quilted look.

6. Heat exchange unit according to claim 5, characterised in that said welding points (34) are distributed in 'quinconce' and/or in square pitch.

7. Heat exchange unit according to claim 1, characterised in that said heat exchangers 13 have a substantially rectangular flattened configuration, with opposite long sides (21) parallel to the axis of the shell (2), and opposite short sides (22a, 22b) arranged radially inside said shell (2) and equipped on opposite short sides (22a, 22b) with connectors for the entry (27) and exit (28) of fluid.

8. Heat exchange unit according to claim 7, characterised in that at least one distributor (35) is fixed to a wall of at least one exchanger (13) in a predetermined intermediate position as regards the two opposite short sides (22a, 22b), connected, on one side, with said chamber (26) of said exchanger (13) and, on the other side, with a duct (39) for feeding fluid.

9. Heat exchange unit according to claim 8, characterised in that said distributor (35) comprises a carter (41) essentially forming a channelling which, when fixed to said metallic plate (23) of said at least one exchanger (13), forms with it a chamber (42) in communication with the inside of the exchanger (13) through a plurality of through-holes (40).

10. Heat exchange unit according to claim 1, characterised in that at least one of said exchangers (13) is internally equipped with a separator plate (46), extending from one side (22a) of said exchanger (13), towards a side (22b) opposite it and from which said plate (46) is in a

predetermined spaced relationship, said separator plate (46) having a predetermined length less than that of said long sides (21), as to which it has a predetermined inclination.

11. Heat exchange unit according to claim 1, characterised in that at least one of said exchangers (13) is internally equipped in correspondence with the opposite long sides (21) of at least one distributor/collector duct (48), said duct (48) being connected, on one side, to said chamber (26) through at least one opening (50) and, on the other side, to the outside of the exchanger (13), through a connector (27).

12. Heat exchange unit according to claim 11, characterised in that said duct (48) is formed directly in a long side (21) of the exchanger (13).

13. Heat exchange unit according to claim 11, characterised in that said at least one exchanger (13) is subdivided into a plurality of chambers (55).

14. Heat exchange unit according to claim 7, characterised in that said plate exchangers (13) define an inner chamber (26) of variable size growing in the direction of the imaginary line joining the connectors (27, 28).

15. Heat exchange unit according to claim 7, characterised in that said plate exchangers (13) define an inner chamber (26) of variable size decreasing in the direction of the imaginary line joining the connectors (27, 28).

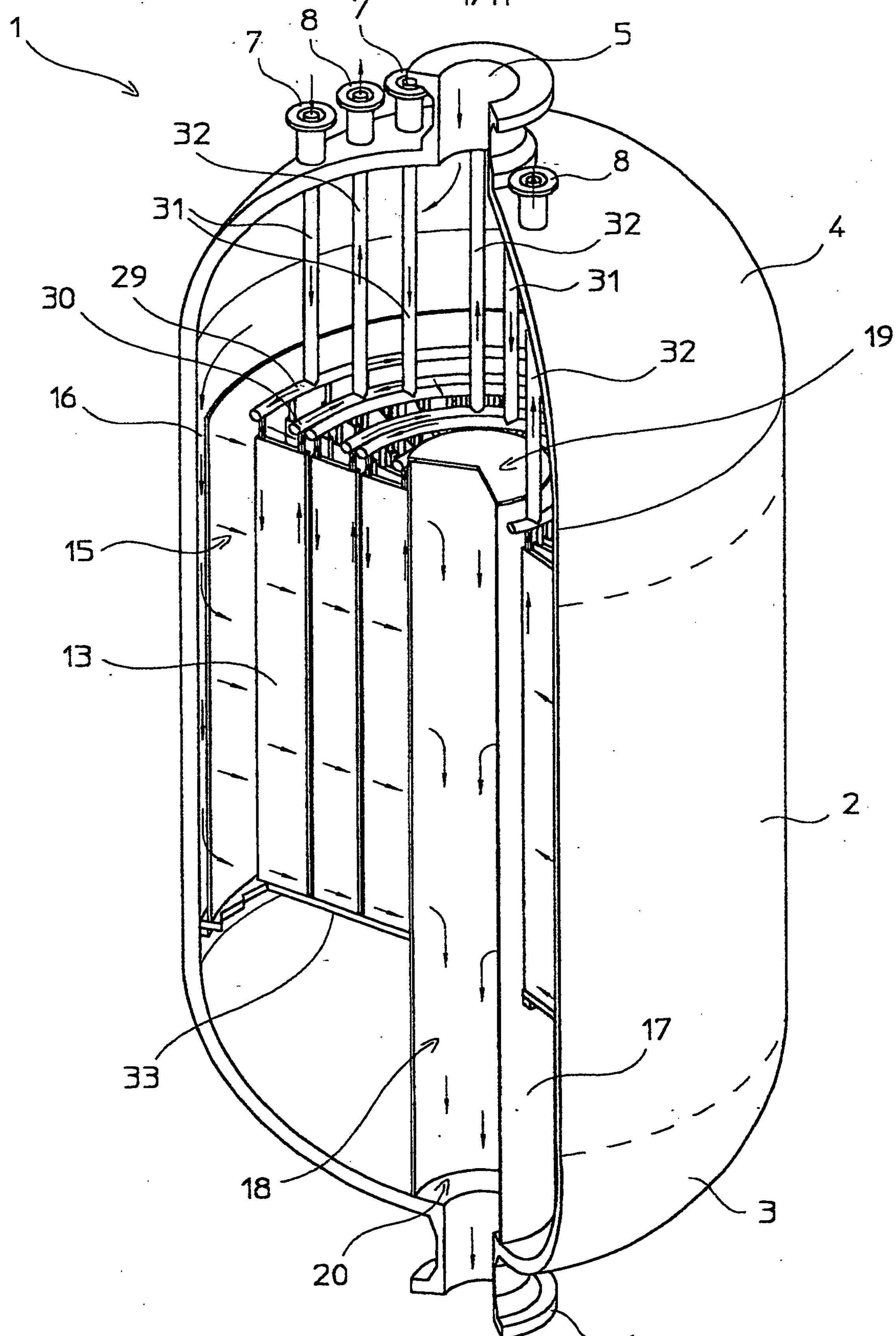

Fig. 1

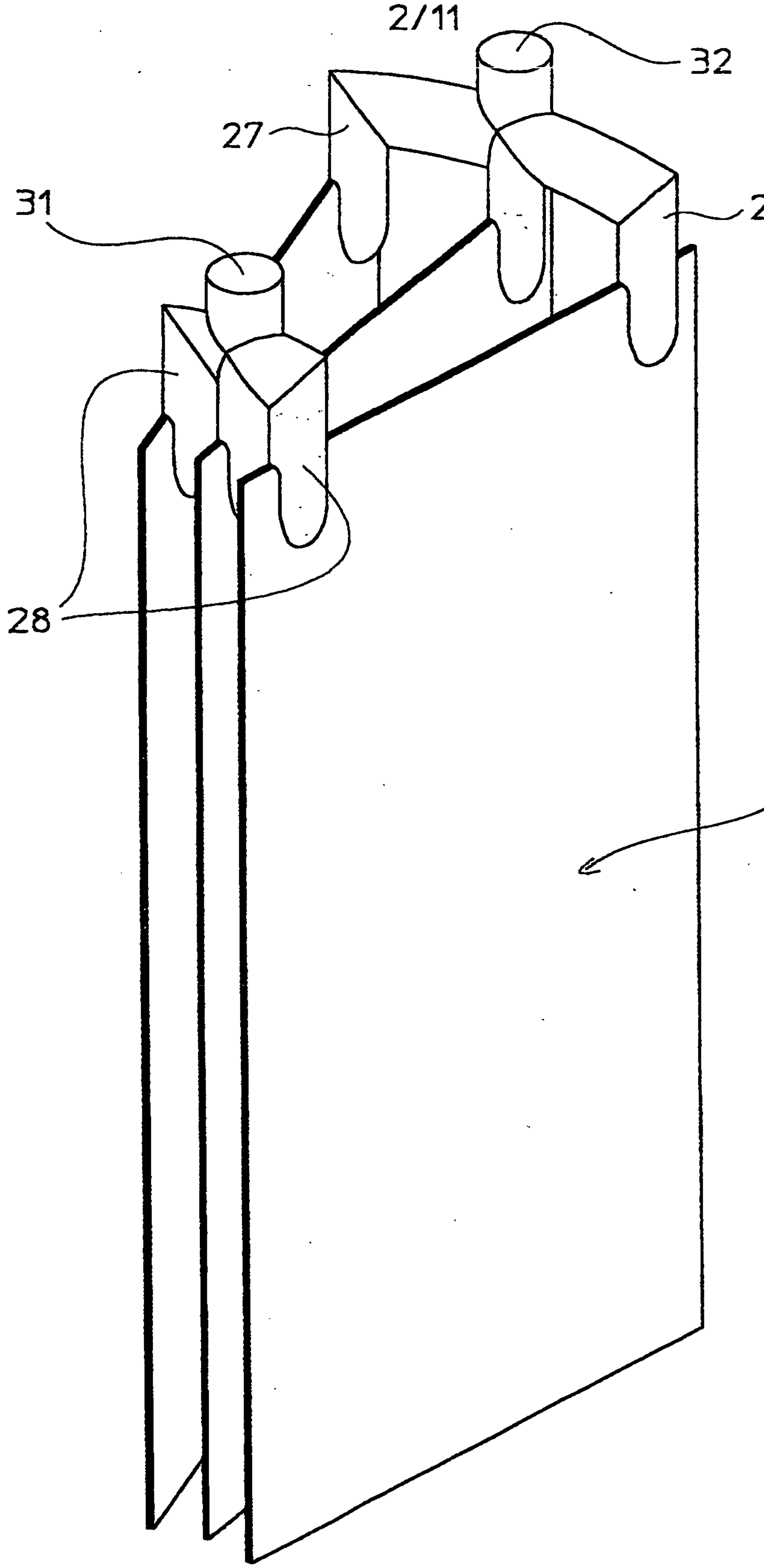

Fig. 2

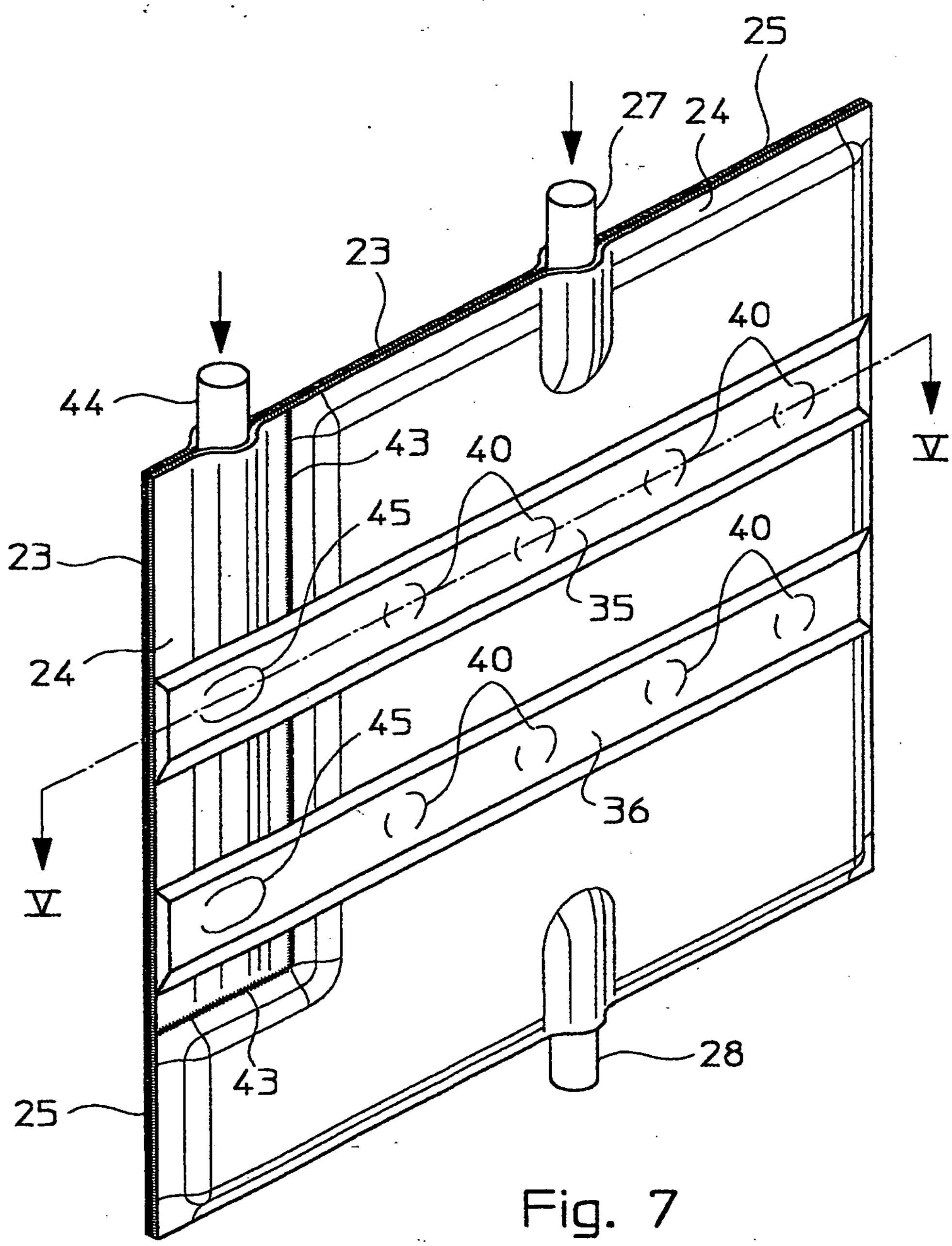
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Fig. 7

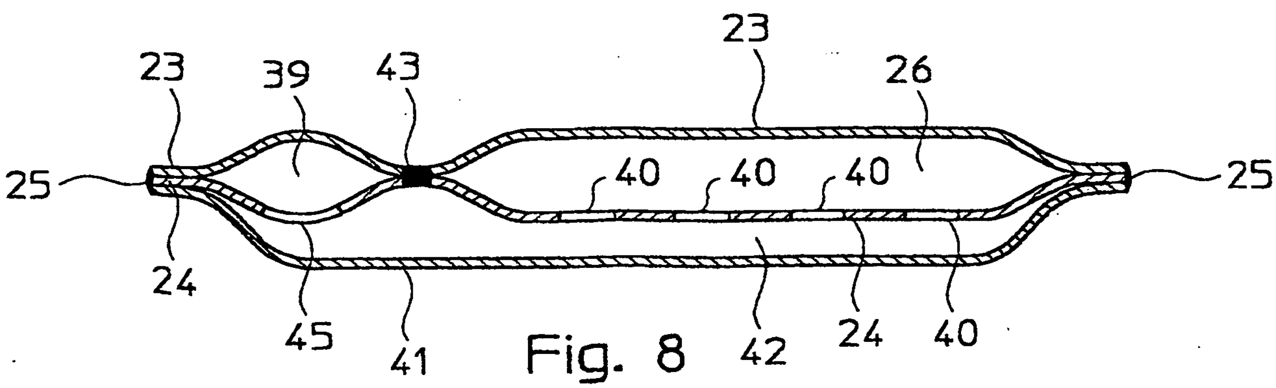
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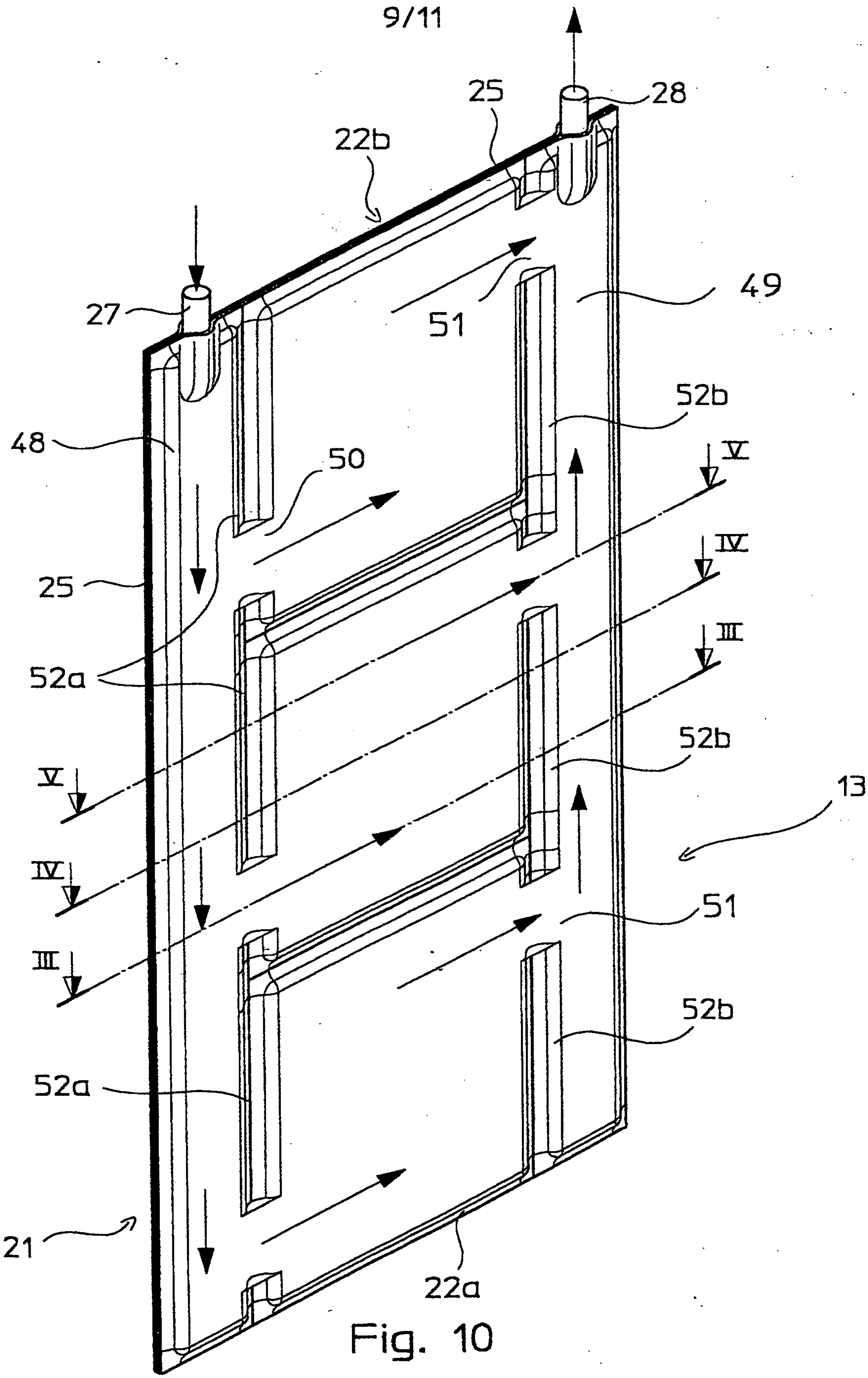
Fig. 8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22b
27
51
49
52b
48
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V
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IV
III
52a
52b
13
V
IV
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III
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52a
21
22a

Fig. 10

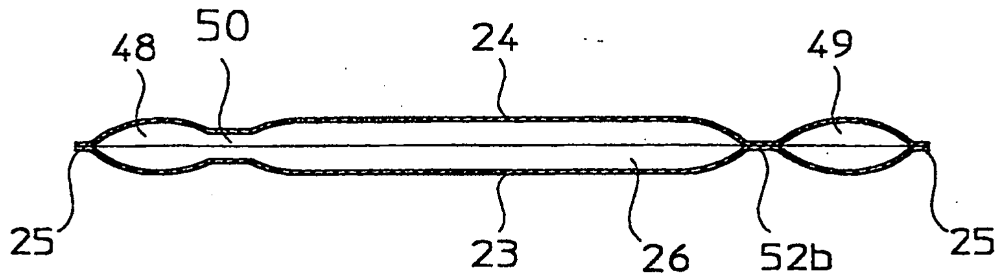

Fig.11

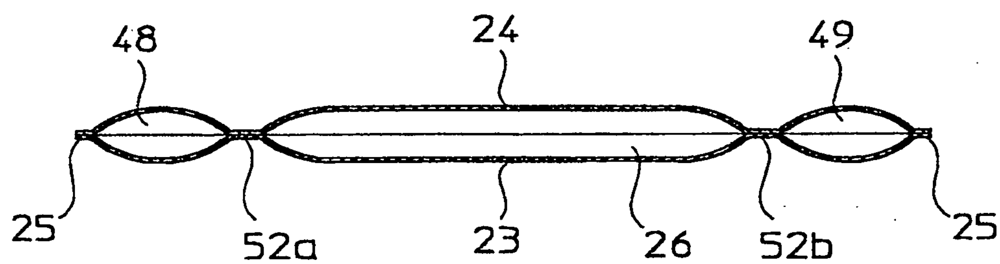

Fig. 12

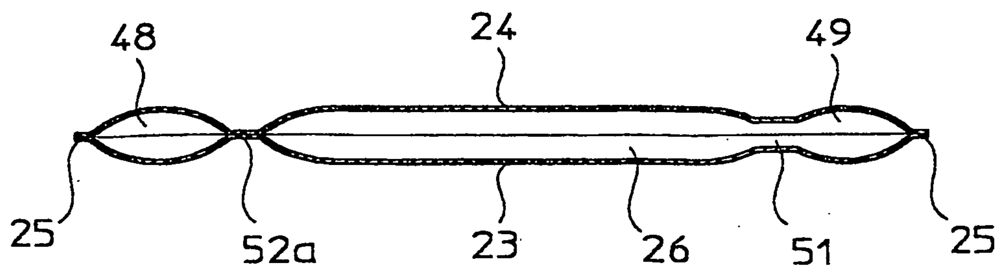

Fig. 13

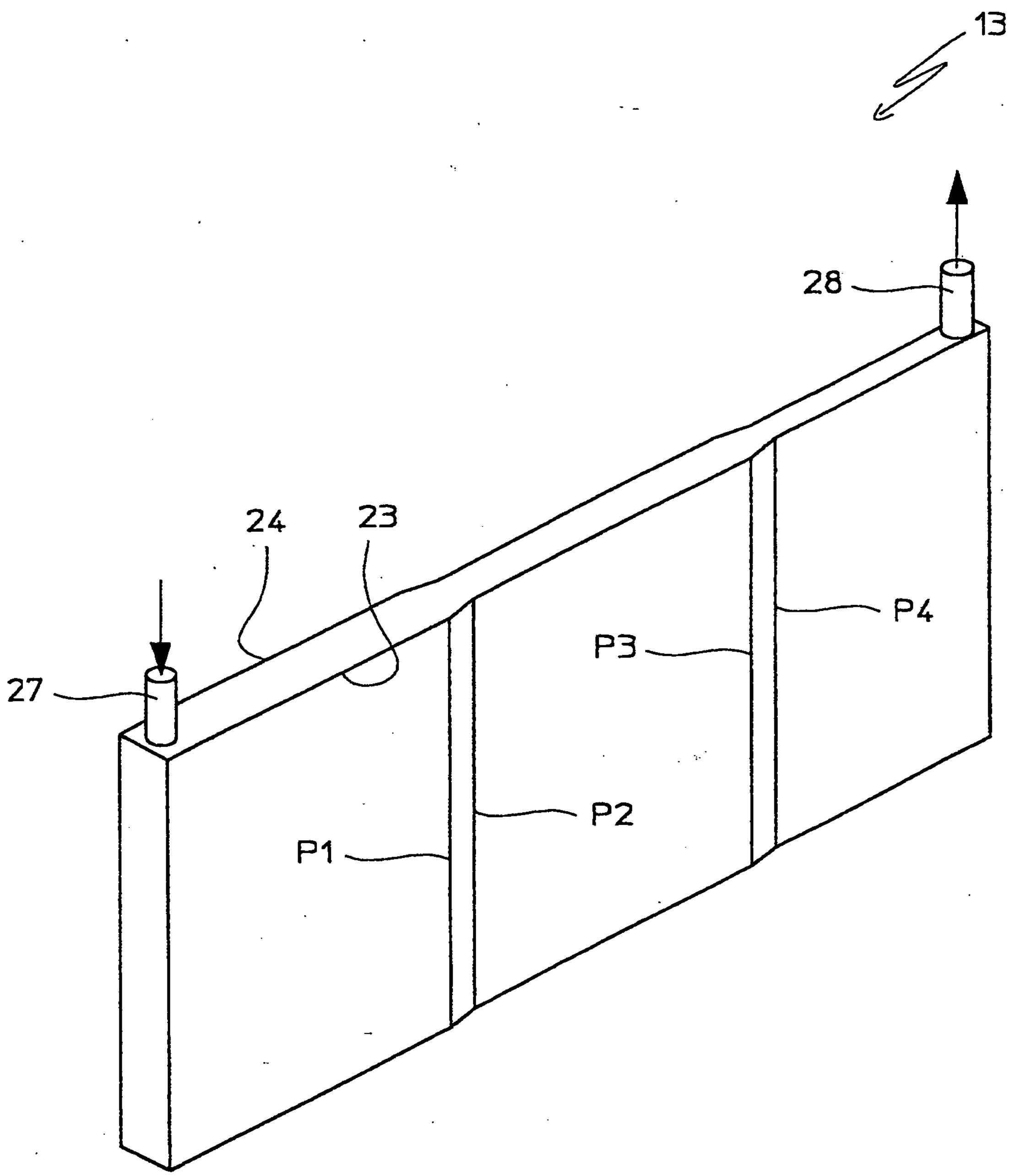

Fig. 14